

Occurrence of Sporadic Human Ascariasis in Non-Endemic Regions: The Importance of Zoonotic Transmission from Swine

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UPDATED ABSTRACT*

Background. Ascariasis in developed countries occurs only sporadically, and usually in travelers or in children in rural settings with exposure to *Ascaris suum* from swine. Reciprocal transmission between humans and swine is possible given *A. suum* and *A. lumbricoides* are considered conspecific based on published mtDNA and nuclear ribosomal ITS-1 studies with recognized phenotypic/genotypic differences reflecting host-specific adaptive changes. Here we evaluated 16 cases of human ascariasis detected over an 8 year period in a non-endemic region of the Upper Midwest USA.

Methods. Helminth specimens (n=16) spontaneously passed per rectum were submitted for laboratory identification during 2013-20 and identified morphologically as *A. lumbricoides/suum* (undifferentiated). All patients attended local clinics and brought specimens in for identification. Clinical records were available for 13 patients.

Results. Ages ranged from 14 months to 41 years with 14 cases (87%) occurring in children <=12 years and 2 (13%) >30 years; 9 patients (56%) were female. Thirteen (81%) of the *A. lumbricoides/suum* specimens were of adults and 2 (19%) were juveniles. Individuals with records available either lived on a farm or hobby farm where pigs were currently or likely historically present; had visited a family farm; lived at a rural address; used animal manure for gardening; or lacked discernable farm connections though was active outdoors. International travel history was lacking in all cases. One 2-year old child from a rural address had passed 2 worms 6 months apart. All 13 patients were treated with albendazole per guideline without complication.

Conclusions. Ascariasis attributable to poor sanitation has been largely eradicated from the USA since the early 1980s. Sporadic infections in non-travelers have continued to be recognized and likely represent zoonotic transmission from domesticated swine. While human and pig *Ascaris* have long been considered distinct species, recently published molecular and cross-transmission experiments point to conspecificity. This case series is a reminder of the zoonotic disease risks posed by swine-origin *Ascaris*, especially in young children, and reinforces the need for proper herd management and attention to personal hygiene for at-risk individuals.

*Updated with an additional case and revised findings.

INTRODUCTION

Ascariasis in developed countries occurs only sporadically, and is usually found in returning travelers who have inadvertently ingested infective *Ascaris lumbricoides* eggs during travels to endemic areas or in children in rural settings with zoonotic exposure to infective *Ascaris suum* eggs from domesticated swine. Historically *A. lumbricoides* and *A. suum* have been treated as separate species based upon morphologic differences in the appearance of the denticules and the shapes of the lips when examined with scanning electron microscopy. Recent molecular evidence targeting primarily mtDNA and nuclear ribosomal ITS-1 has, however, brought the importance of the morphologic differences into question with the two species now considered to be closely related or conspecific, depending upon the study. While subtle phenotypic and genotypic differences remain detectable between individual *Ascaris* worms recovered from humans and swine, these are felt to reflect more on host-specific adaptive changes within a species rather than on differences between species. Here we evaluated 16 cases of human ascariasis detected over an 8-year period in an area of the Upper Midwest USA non-endemic for ascariasis. None of these infections occurred in out-of-country travelers, suggesting that infection with *A. lumbricoides* was unlikely. Our study largely mirrored findings reported upon previously from Maine.

MATERIALS AND METHODS

Helminth specimens (n=16) spontaneously passed per rectum were submitted by patients or their healthcare provider at regional clinics for laboratory identification during 2013-20 and were identified morphologically as *A. lumbricoides/suum*. Laboratory reports did not differentiate between these species and no further testing was performed. Clinical records were available for 13 patients and reviewed for public health significance.

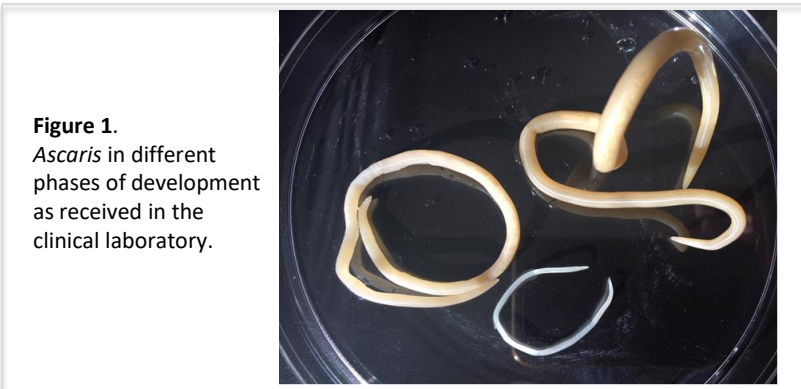


Figure 1. *Ascaris* in different phases of development as received in the clinical laboratory.

RESULTS

- Helminth specimens (n=16) were passed spontaneously per rectum and submitted for laboratory analysis (see Figure 1).
- Patient ages ranged from 14 months to 41 years with 14 cases (87%) occurring in children <=12 years (50% were in children < 4 years of age) and 2 (13%) >30 years (see Table 1).
- Nine (56%) patients were female and 7 (44%) male.
- Thirteen (81%) of the *A. lumbricoides/suum* specimens were adults and 3 (19%) were juveniles; the latter were recovered from children aged 17, 20 and 32 months of age.
- Individuals with records available either lived on a farm or hobby farm where pigs were currently or likely historically present; had visited a family farm; lived at a rural address; used animal manure for gardening; or lacked discernable farm connections though was active outdoors.
- International travel history was lacking in all cases.
- One 2-year old child from a rural address had passed 2 worms 6 months apart.
- All 13 patients with records available were treated with albendazole per guideline without complication.

Table 1. Characteristics of sporadic *Ascaris* infections included in this study from the Upper Midwest USA, a non-endemic region, 2013-2020.

Patient	Patient Age/Gender	Helminth Stage	Treatment	Comments
1	14MO/F	Adult	Albendazole	Visit to family farm
2	15MO/F	Adult	Albendazole	Visit to family farm
3	17MO/M	Juvenile	NA	NA
4	20MO/F	Juvenile	Albendazole	Hobby farm
5	26MO/M	Adult	NA	NA
6	32MO/M	Juvenile	Albendazole	Rural address
7	34MO/M	Adult	Albendazole	Rural address
8	41MO/F	Adult	Albendazole	Farm
9	4YO/F	Adult	NA	NA
10	4YO/F	Adult	Albendazole	Farm with swine
11	5YO/F	Adult	Albendazole	Rural address
12	6YO/M	Adult	Albendazole	Farm
13	7YO/M	Adult	Albendazole	Farm with swine
14	11YO/M	Adult	Albendazole	Hobby Farm
15	32YO/F	Adult	Albendazole	Animal manure use
16	41YO/F	Adult	Albendazole	Active outdoors

CONCLUSIONS

- Ascariasis attributable to poor sanitation has been largely eradicated from the USA since the early 1980s.
- Sporadic infections in non-travelers have continued to be recognized and likely represent zoonotic transmission from domesticated swine.
- While human and swine *Ascaris* have long been considered distinct species, recently published molecular and cross-transmission experiments point to conspecificity.
- This case series is a reminder of the zoonotic disease risks posed by swine-origin *Ascaris*, especially in young children, and reinforces the need for proper herd management by farmers and attention to personal hygiene for at-risk individuals.

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Selected References available upon request

